Kepler Communications Inc.
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Before the
Federal Communications Commission
Washington, D.C. 20554

In the Matter of	)	
	)	
Kepler Communications Inc.	)	IBFS File No. SAT-LOI-20161115-00114
	)	
Petition for a Declaratory Ruling Granting Access to the U.S. Market for the Kepler NGSO FSS System	)	(Call Sign S2981)

CONSOLIDATED RESPONSE TO COMMENTS OF KEPLER COMMUNICATIONS INC.

Kepler Communications Inc. (Kepler) hereby responds to the comments filed with respect to its application for market access for a non-geostationary satellite orbit (NGSO) fixed-satellite service (FSS) system. Kepler has invested significant resources to ensure that its system is safe, efficient and serves the public interest. Through the scheduled launch of its low-cost nano-satellite infrastructure in the coming months, Kepler will be the first applicant to begin commercial operation within the processing round – allaying any concerns of spectrum warehousing. Kepler will complete its constellation at a fraction of the cost of other applicants and incumbents, putting Kepler in a truly unique position to offer low-cost data backhaul services for the billions of devices that will power the information age.

Kepler has designed its system with spectrum sharing and continuous improvement in mind. With a 3-year replenishment cycle, the system will be at the forefront of technical advancements for both throughput and spectrum sharing. Despite this rapid replenishment cycle, the system is still compliant with all debris requirements and poses no risk to the general public upon re-entry. Through the use of a Software Defined Radio (SDR), the system can vary bandwidth, emit power and center frequency – as such Kepler is well positioned to share spectrum resources with new entrants and coordinate with incumbents.

The Commission has gone to great lengths to ensure Kepler's system complies with all applicable regulations. Kepler has been transparent and forthcoming with requests for information, particularly with regards to the operation of its SDR and its Equivalent Power Flux Density (EPFD) compliance showing. Despite this, some commenters mistakenly believe that due to the lack of propulsion, Kepler's EPFD showing is incomplete. As will later be discussed, this is factually inaccurate; Kepler's system conforms to the requirements of EPFD despite its lack of station keeping.

Kepler's system will provide the capability to connect devices and people to information around the globe at an unprecedented cost for satellite connectivity. This has generated strong customer demand,

and an accelerated commercial timeline for Kepler, with the first satellites expected to launch in 2017. When compared to other applicants, Kepler remains in a unique position to offer this sought-after service, accordingly - grant of this application would clearly serve the public interest.

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I. Kepler Has Designed an Ambitious NGSO Constellation to Meet the Growing Demand for High-Capacity, Low Cost Data Backhaul Service

Kepler has designed its NGSO constellation to provide services demanded by the public that are unique from proposed systems within the current processing round initiated by WorldVu. Unlike other applicants, Kepler intends to service Internet of Things (IoT) devices across the globe, at a price point significantly below what other operators are currently offering or will be capable of offering with new systems. Despite the unique offering that Kepler's system will provide, SpaceX has questioned the apparent limited capacity of the system[1]. In supporting its argument, SpaceX has referenced the use of V-band spectrum in 15 MHz blocks. Kepler has not applied to use any portion of V-band and this comment by SpaceX shows they may not have taken adequate time to fully investigate the merit of Kepler's system. Rather than dismiss SpaceX's comments altogether and in the interest of constructive progress, the reasonable assumption will be taken that SpaceX was in fact referring to Kepler's Ku-band operations.

Kepler has made it clear that the SDR is capable of altering the channel bandwidth based on customer demand to a maximum of 200 MHz on a single channel with its Phase I satellites. Where such a large channel is not required, the system will be able to reduce the size of the channels and provide access to multiple stations at once. Contrary to SpaceX's comments, such robustness and diversity are in the interest of spectral efficiency and may provide other operators access to more spectrum when Kepler does not require it. Furthermore, the system agility allows Kepler to offer a comprehensive package of varying capacities to end users which in turn provides Kepler with the ability to be price elastic for its end users.

Kepler agrees with SpaceX's position regarding the Commission's directive[2], with one alteration – namely that the directive does not specify "broadband" but more broadly states "communication services"[3], as broadband is just one of many services demanded by the public. The Commission's directive must consider the integration of diverse service offerings within the processing round, each with their own merit to serve the public interest. It goes without saying that

[1] *See Comments Of Space Exploration Holdings, LLC*, at 2 (Sept. 11, 2017) ("SpaceX Comments").
[2] *See Consolidated opposition to petitions and response to comments of space exploration holdings, LLC*, at I. 1, File No. SAT-LOA-20161115-00118 (Jul. 7, 2017)("SpaceX Response").
[3] 47 U.S.C. § 151.

Kepler will be in a prime position to fulfill the requirements of a "rapid, efficient, nation-wide… service with adequate facilities at reasonable charges"[4].

II. The Advanced Technology Used in Kepler's System Will Enhance its Ability to Share Spectrum and the Use of Low-cost Spacecraft Mandates Operational Considerations

SpaceX has raised a concern regarding the 8-10° beam width of Kepler's Phase I system citing the beamwidth could make it difficult for co-existence with other NGSO. This contradicts the Commission's approved declatory ruling from June of 2017 that confirms OneWeb, whose beams can be as wide as 40 degrees[6], with significantly more satellites, is capable of avoiding inline interference events and effectively sharing spectrum.

Kepler continues to highlight that the information provided to the Commission is conservative and that the technology used within the system will be continually improved. Kepler is the process of developing its second-generation antenna which will boast improved beamwidth, sidelobe performance and multi-access capabilities. Just as SpaceX has highlighted the fact that it "does not intend to freeze the design process for its spacecraft at the first launch"[5], neither has Kepler. Given that the commission has granted OneWeb's application[6], this argument of "pos[ing] challenges for coexistence"[7] seems moot.

Kepler has built its constellation on the principle of using nano-satellites without propulsion. While using such hardware comes with a cost advantage, it also means that the system must stabilize itself before directional antennas can be used to communicate with the system. During the Launch and Early Operation Phase ("LEOP"), Kepler must use a non-directional, low frequency antenna on board its satellite to relay information for stabilization. In order to achieve this, Kepler operates telemetry, tracking, and command ("TT&C") within the UHF/VHF segment for Phase I satellites. Once the satellite is stabilized, Kepler transitions TT&C operations to in-band Ku, as required by the Commission. This TT&C operation in-band will be part of a conventional gateway downlink operation and would not modify any of Kepler's EPFD showings. The

[4] *Id.,* emphasis added
[5] *See APPLICATION FOR APPROVAL FOR ORBITAL DEPLOYMENT AND OPERATING AUTHORITY FOR THE SPACEX NGSO SATELLITE SYSTEM,* IBFS File No. SAT-LOA-20161115-00118*,* at Page 8 *(Nov. 17, 2016) ("SpaceX Application")*
[6] *See WorldVu Satellites Limited Petition for a Declaratory Ruling Granting Access to the U.S. Market for the OneWeb NGSO FSS System*, File No. SAT-LOI-20160428-00041, Order and Declaratory Ruling, FCC 17-77, at 18 (Jun. 23, 2017) (the "OneWeb Market Access Grant")
[7] *See* SpaceX Comments, at 3

Commission is also reminded that Kepler does not intend to operate TT&C stations within the United States, at least for the first phase of operations. In the countries where TT&C will operate, Kepler has requested appropriate waivers for out of band TT&C, which will only be used on a temporary (up to 3 months) basis for LEOP.

SpaceX has further highlighted concerns with one of the methods Kepler has highlighted to avoid inline interference. They fail to highlight other possible methods in paragraphs above the one mentioned. Since writing the application, the Commission has specified and opened for comment how it envisions in-line events will be triggered[8]. Kepler will comply with those and other international requirements for avoiding interference during inline events, be they as a reference from the ground or space. Regardless of published material, Kepler's system is just as capable as any other to coordinate inline events. The methodology by which two systems (or multiple) will avoid interference will continuously be subject to bilateral conversation and agreements based on the Commission's rules.

III. Kepler Has Provided the Commission All Information Necessary to Verify EPFD Compliance

SES/O3b have raised unfounded concern with regards to Kepler's ability to meet EFPD and further exaggerated the potential effect that a variance in altitude over the operational lifetime of the satellite may have on EPFD results. Furthermore SES/O3b have urged the Commission to ensure that Kepler's system meets the aggregate EPFD limits in section 25.208(h).[9] In an ex-parte presentation, OneWeb has questioned the earth station density figure used by Kepler for its EPFD calculations and mistakenly reported it as understated by 300% and artificially lowering EPFD - indirectly suggesting that the compliance demonstration is invalid.[10] Kepler has fully demonstrated EPFD compliance and cooperated with all requests by the Commission to demonstrat both Kepler's understanding of EPFD and conformance.

Despite SES/O3b's claim that the "altitude of Kepler's satellites will decrease by tens of kilometers"[11], these deviations have no significant impact on the EFPD results. Kepler has assessed the sensitivity of its constellation to changes in altitude and has found that within a 50 Km range

[8] *See REPORT AND ORDER AND FURTHER NOTICE OF PROPOSED RULEMAKING,* IB Docket No. 16-408, at 45-48 (Sept. 7, 2017)("NPRM Report")
[9] *See Comments SES S.A. and 03b Limited*, at 5 (Sept. 11, 2017) ("SES/O3b Comments").
[10] *See Letter from Brian D. Weimer to Marlene H. Dortch*, Notice of Ex Parte Presentation in IB Docket No. 16-408, Exh 1 at 28 (Sept. 10, 2017)("OneWeb Comments")
[11] *See SES/O3b Comments*, at 7.

of the nominal altitude, there is little effect to the system's overall impact on interference with GEO systems. Furthermore, within its EPFD showing, Kepler has run the simulation using a nominal altitude of 575 Km rather than the anticipated initial operational altitude of 600 Km. This is highly conservative as it assumes that all spacecraft are operational at 575 Km at a single point in time, which is factually inaccurate. At no point would Kepler's system be operating under such a condition, as the satellites will be scattered between deployment altitudes and end of operational life altitudes. Given an initial launch altitude of 600 Km, Kepler spacecraft are only expected to drop between 6 - 13 km in altitude during their operating life – once again making the entire assessment overly conservative.

SES/O3b have further petitioned the Commission to impose aggregate EPFD limits on all NGSO systems operating in Ku-band[12]. This issue has been raised in the past by ViaSat with regards to interference from multiple NGSO systems into GSO operations[13] as well as ViaSat's concerns with OneWeb's NGSO system[14]. Not only has the Commission rejected ViaSat's petition for revision[15], but the concern of aggregate EPFD has been addressed by OneWeb in their comments of the NGSO NPRM. Within these comments, OneWeb explained how the avoidance of in-line events will reduce the chance of beams from multiple NGSO systems overlapping, effectively alleviating GSO operator's concerns.[16] Regardless, ITU Radio Regulations specify that if the EPFD limits are met, an NGSO FSS system is effectively coordinated with GSO systems. In terms of aggregate limitations on EPFD, the Commission has imposed conditions on the OneWeb system which Kepler believes can be effectively applied to all systems. Kepler also understands that its operations will be subject to any new rules on aggregate EPFD that may be adopted in the current NGSO NPRM proceeding.

O3b has further requested that the Commission ensure that Kepler's SDR has the capability of maintaining its interference profile regardless of altitude.[17] On March 21, 2017 the Commission requested further information from Kepler with regards to its market access application.[18] Within

[12] *See SES/O3b Comments*, at 5.
[13] *See Petition to Deny or Impose Conditions of ViaSat, Inc*., IBFS File No. SAT-LOA-20161115-00117, et al. ("ViaSat Petition")
[14] *See Letter from John P. Janka to Marlene H. Dortch*, IBFS File No. SAT-LOI-20160428-00041, Exh. A at 15 (June 13, 2017).
[15] *See OneWeb Market Access Grant* ¶ 25.a and n.74
[16] *See Reply Comments of OneWeb*, IB Docket No. 16-408, at 8 (Apr. 10, 2017).
[17] *See SES/O3b Comments*, at 7.
[18] *See Letter From The Commission,* IBFS File No. SAT-PDR-20161115-00114, (Mar. 21, 2017) ("Commission Letter")

this request, the Commission requested further detail on Kepler's SDR and EPFD compliance.[19] In previous letters and presentations, Kepler has demonstrated to the Commission in great detail how its SDR is capable of adjusting multiple operating parameters in order to comply with applicable regulations and facilitate spectrum sharing.[20] Despite the fact that this information gives detailed insight into Kepler's intellectual property, this information was not requested to be kept confidential. In the matter of EPFD compliance, Kepler has clearly demonstrated its capability to comply with regulations and its intent to protect GSO operators regardless of satellite altitude.

In an ex-parte presentation made by WorldVu, Kepler's density figure used in its EPFD calculation is presented as "artificially lower[ing] EPFD results".[21] While this may be factually accurate, its affect is overstated and had WorldVu run an assessment this would have been clear. At the order of magnitude presented for Kepler's density figure, the characteristic figure has little impact on driving EPFD. The combination of average distance and density combined are what drive the result and regardless of the characteristic figure. For further clarity, if the modified figures presented in WorldVu's ex-parte presentation are used at a conservative 575 Km orbit for all satellites, Kepler's system will still be capable of complying with EFPD requirements.

O3b has further noted that they believe Kepler has mistakenly labelled the alpha (α) angle in the Technical Narrative as the exclusion zone. The exclusion zone within Kepler's Technical Narrative is labelled as γ (gamma), which is correct for Kepler's internal definitions that drive the creation of PFD masks – not to be confused with the ITU alpha (α) definition in ITU-R S.1503 as O3b has done. For further clarity, in Kepler's Technical Narrative alpha (α) is used to denote NGSO-centric azimuth[22].

O3b claims the current ITU software exclusion zone is always constant despite satellite latitude and thus cannot be varied. O3b is correct in asserting that the ITU software is limited and can only run for a fixed exclusion zone (α - alpha as defined in ITU-R S.1503) independent of latitude. Within its filings Kepler has included a constant minimum exclusion angle however, similar to other NGSO filings, Kepler modifies its EIRP based on latitude within its PFD masks to reduce side lobe interference.[23] These modifications to EIRP are discussed in the technical

[19] *See Commission Letter,* at 3,7 and 8
[20] *See Kepler Response to Request for Further Information,* IBFS File No. SAT-LOI-20161115-00114, at 3 (Apr. 20, 2017), Additional Information for 140 Satellite Filing, IBFS File No. SAT-LOI-20161115-00114, at 2,3 and 5
[21] *See OneWeb Comments,* at 28
[22] *See Figure 4 Kepler Technical Narrative Pg. 9*
[23] *See Space-X Technical Attachment ("sidelobe nulling"),* IBFS File No. SAT-LOA-20161115-00118, at 38-40 (Nov 15, 2016); *OneWeb Technical Attachment*, IBFS File No. SAT-LOI-20160428-00041, at A1-3 point (c) (Apr 28, 2016)

narrative as referenced by O3b however, O3b mistakenly relates the "exclusion" angles to the ITU variable alpha (x_zone) where in fact they are used within the calculation of Kepler's PFD masks to vary power output as a function of latitude and hence EIRP. While O3b's comments are understandable, they are not factually accurate with respect to the generation of Kepler's EPFD masks and appear to stem from incorrectly intertwining ITU variable definitions with Kepler's own nomenclature.

Kepler has clearly demonstrated its ability to conform to EPFD requirements and has at all times used conservative figures to represent its system. It is further expected that with future releases of ITU-R S.1503, as shortcomings in the software are addressed - Kepler's system will be shown as more conservative.

IV. Granting Kepler's Request for Waivers Would Not Undermine the Commission's Rules

Kepler has demonstrated to the Commission that it is on track to deploy its first satellite towards the end of 2017. While a significant portion of other applicants in the processing round have proposed to use the spectrum for broadband connectivity, Kepler has not. Broadband communication requires a significant portion of a constellation to be complete prior to commercial operation in NGSO. Due to its unique store and forward proposition, Kepler's system does not have any such requirement. As a result, Kepler's system will be in a position to fully utilize its spectrum allocation for commercial use as of the first operational satellite - not only in the US, but globally. Any argument that suggests waivers would result in unused spectrum or limiting its availability to other operators is unfounded.

Given the Commissions proposition with regards to inline events and spectrum sharing[24], the notion that any participant within the processing round would be capable of warehousing spectrum is highly unlikely. Kepler is on track to being the first system in operation in the processing round and given its reduced capital requirement to complete the constellation when compared to other entrants, Kepler could very well be the first to complete its constellation. Kepler's request for waivers are in the public interest of ensuring a timely and secure deployment of the constellation and there is no risk presented to other systems with regards to warehousing of spectrum and orbital resources.

[24] *See NPRM Report*

V. Kepler Should Not be Bound by Dated Conditions

O3b has specified that Kepler's system should be subject to conditions set out in O3b's Market Access Grant.[25] O3b has done so despite its own knowledge that the Commission has found some of these conditions unnecessary.[26] Kepler strongly objects to the inclusion of any conditions purely on the merit that they have been imposed on prior operators using a different class of spacecraft, with differing orbital parameters, and serving a different class of customer requirements. These conditions were also imposed on a grant that was issued prior to release of the NPRM Report and grant of WorldVu's OneWeb constellation. As such the Commission should dismiss O3b's petition to reproduce dated conditions within Kepler's grant and instead include language that is applicable and consistent with the grants of other operators within the processing round and the NPRM Report.

VI. Request for Waiver

To the extent necessary and out of an abundance of caution, Intelsat respectfully requests a waiver of Section 25.154(c) of the Commission's rules, which requires that oppositions be filed within ten days after a petition to deny was filed.[27] Despite Kepler's best efforts it was unable to complete its response to all commenters in the given time period.

The FCC may grant a waiver for good cause shown.[28] The Commission typically grants a waiver where the particular facts make strict compliance inconsistent with the public interest.[29] In granting a waiver, the Commission may take into account considerations of hardship, equity, or more effective implementation of overall policy on an individual basis.[30] Waiver is therefore appropriate if special circumstances warrant a deviation from the general rule, and such a deviation will serve the public interest.

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[25] *See O3b Limited, Call Sign S2935, File Nos. SAT-LOI-20141029-00118 & SAT-AMD-20150115-00004,* grant-stamped Jan. 22, 2015, corrected and re-issued June 2, 2015 ("O3b Market Access Grant").
[26] *See SES/O3b Comments,* footnote 12
[27] *See* 47 C.F.R. § 25.154(c).
[28] *See* 47 C.F.R. § 1.3
[29] *See N.E. Cellular Tel. Co. v. FCC*, 897 F.2d 1164, 1166 (D.C. Cir. 1990) ("Northeast Cellular").
[30] *See WAIT Radio v. FCC, 419 F.2d 1153, 1159 (D.C. Cir. 1969); Northeast Cellular, 897 F.2d at 1166.*

In this case, good cause exists for a waiver of Section 25.154(c) because WorldVu did not inform Kepler of its Ex-Parte presentation which indirectly commented on Kepler's EPFD showings. Kepler became aware of the details of the presentation on September 19, 2017, when outside council informally alerted Kepler to its particulars. This indirect comment delayed Kepler's filing and necessitated response as WorldVu requested "the Commission refrain from acting on these applications until the concerns … are adequately resolved".[31] Given these facts, it is in the public interest for the Commission to waive Section 25.154(c) on equitable grounds.

VII. Conclusion

Kepler has developed a novel antenna array and SDR capable of operation using a nano-satellite to form part of a highly efficient, and rapidly refreshed NGSO constellation that will be capable of sharing spectrum equitably with other users. In doing so, Kepler has designed the entire constellation to meet or exceed the regulatory, safety, and operational guidelines set in place by the Commission, and other international regulators. While very few comments were filed in response to Kepler's application, it is reassuring to see that these were filed by knowledgeable and established operators in the industry whose concerns were both understandable and addressable. As demonstrated above, the comments do not warrant the Commission delaying Kepler's application being granted and allowing the commencement of commercial operation towards the end of 2017. This will allow Kepler to deploy a truly low-cost data backhaul service for the billions of devices powering the information age.

Respectfully submitted,

Kepler Communications Inc. - Sept 25, 2017
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[31] *See OneWeb Comments,* at 1